

Heat-Associated Deaths in Maricopa County, AZ Final Report for 2016



Photograph by Dan Sorensen:

<http://www.dansorensenphotography.com/>



Maricopa County Department of Public Health

<http://www.maricopa.gov/publichealth/>

ACKNOWLEDGEMENTS.....	2
INTRODUCTION	3
RESULTS	4
Heat-Associated Deaths by Year	4
Heat-Associated Deaths by Month	5
Heat-Associated Deaths and Temperatures	6
Heat-Associated Deaths by Residency	6
Heat-Associated Deaths by Time Spent in Arizona	8
Demographic Characteristics of Heat-Associated Deaths	9
Heat-Associated Death Rates.....	11
Potential Years of Life Lost	12
Heat-Associated Deaths by Place of Injury	14
Air Conditioning Use for Indoor Deaths	166
Substance Use among Heat-Associated Deaths	18
Living Situation among Heat-Associated Deaths	19
CONCLUSIONS	21
APPENDIX.....	22
Background.....	22
Methodology	22
Appendix Tables	24

Acknowledgements

The Maricopa County Department of Public Health (MCDPH), Office of Epidemiology would like to thank the following agencies for their contributions to this report:

- Maricopa County Office of the Medical Examiner (OME)
- Maricopa County Office of Vital Registration (OVR)
- Arizona Department of Health Services (ADHS), Office of Vital Registration
- National Weather Service (NWS)
- Maricopa Association of Governments (MAG)
- Local hospitals (infection preventionists, emergency departments, social worker staff)
- City of Phoenix Heat Relief Network

Introduction

Mortality from environmental heat is a significant public health problem in Maricopa County, especially because it is largely preventable. Maricopa County has conducted heat surveillance since 2006. Each year, the enhanced heat surveillance season usually begins in May and ends in October. The main goals of heat surveillance are to identify the demographic characteristics of heat-associated deaths (e.g., age and gender) and the risk factors for mortality (e.g., homelessness). Sharing this information helps community stakeholders to design interventions in an effort to prevent heat-associated deaths among vulnerable populations.

The two main sources of data for heat surveillance are: preliminary reports of death (PRODs) from the Office of the Medical Examiner (OME) and death certificates from the MCDPH Office of Vital Registration.

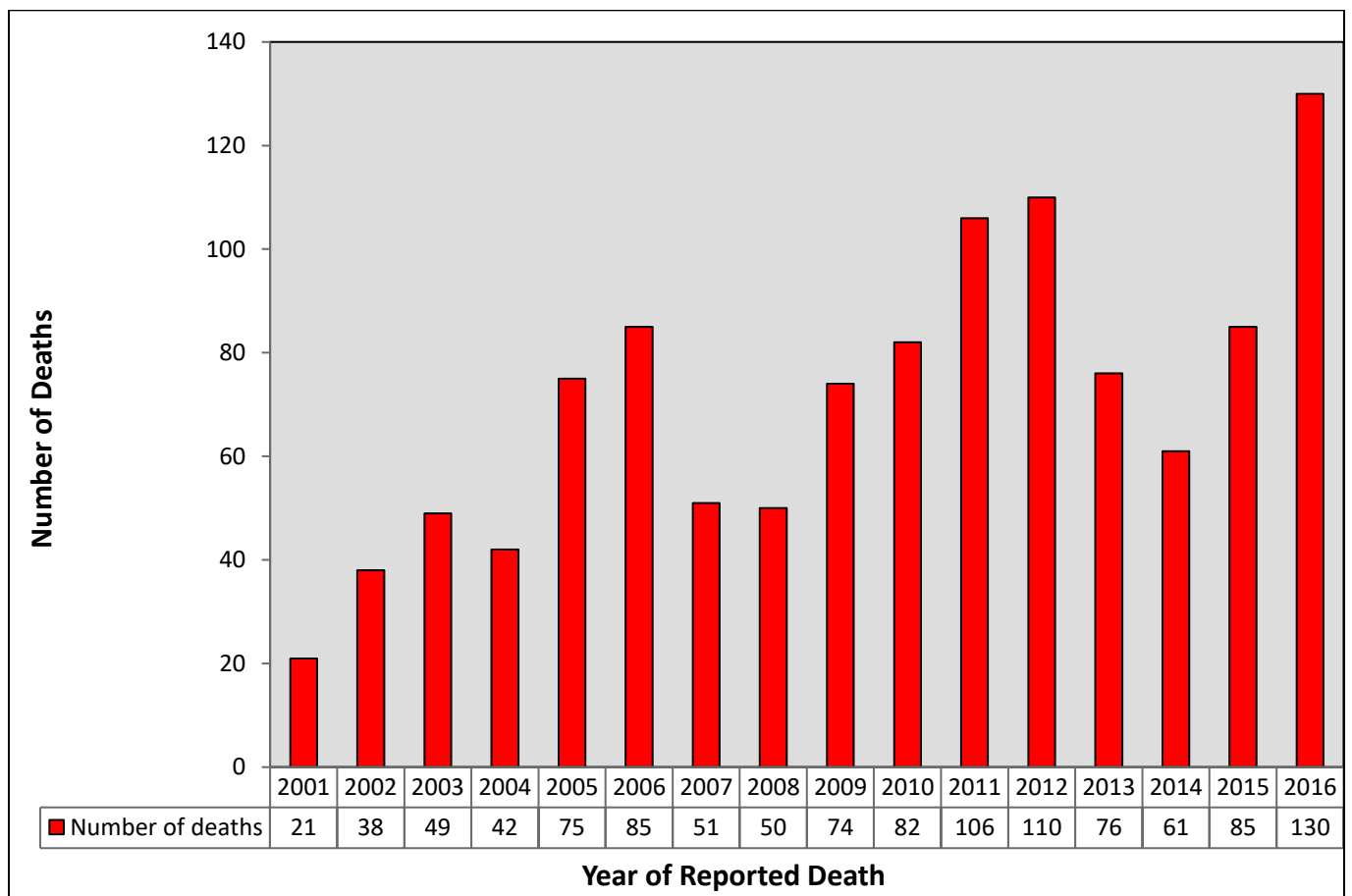
Heat-associated deaths are classified as heat-caused or heat related. Heat-caused deaths are those in which environmental heat was directly involved in the sequence of conditions causing deaths. Heat-related deaths are those in which environmental heat contributed to the deaths but was not in the sequence of conditions causing these deaths. For more information on how heat-associated deaths are classified, see the [definitions in Appendix](#). For more information on MCDPH's surveillance system, see [Background](#) and [Methodology](#).

Results

Heat-Associated Deaths by Year

- There were 130 heat-associated deaths reported in 2016.
- Twenty seven cases are still pending classification.
- See Appendix [Table A](#) for more information about the number of confirmed, ruled-out, and pending cases by year.

Graph 1. Confirmed Heat-Associated Deaths by Year (n=1,135), Maricopa County, 2001-2016*



Data Sources: Maricopa County, Office of Vital Registration and Office of Medical Examiner; Arizona Department of Health Services, Office of Vital Registration

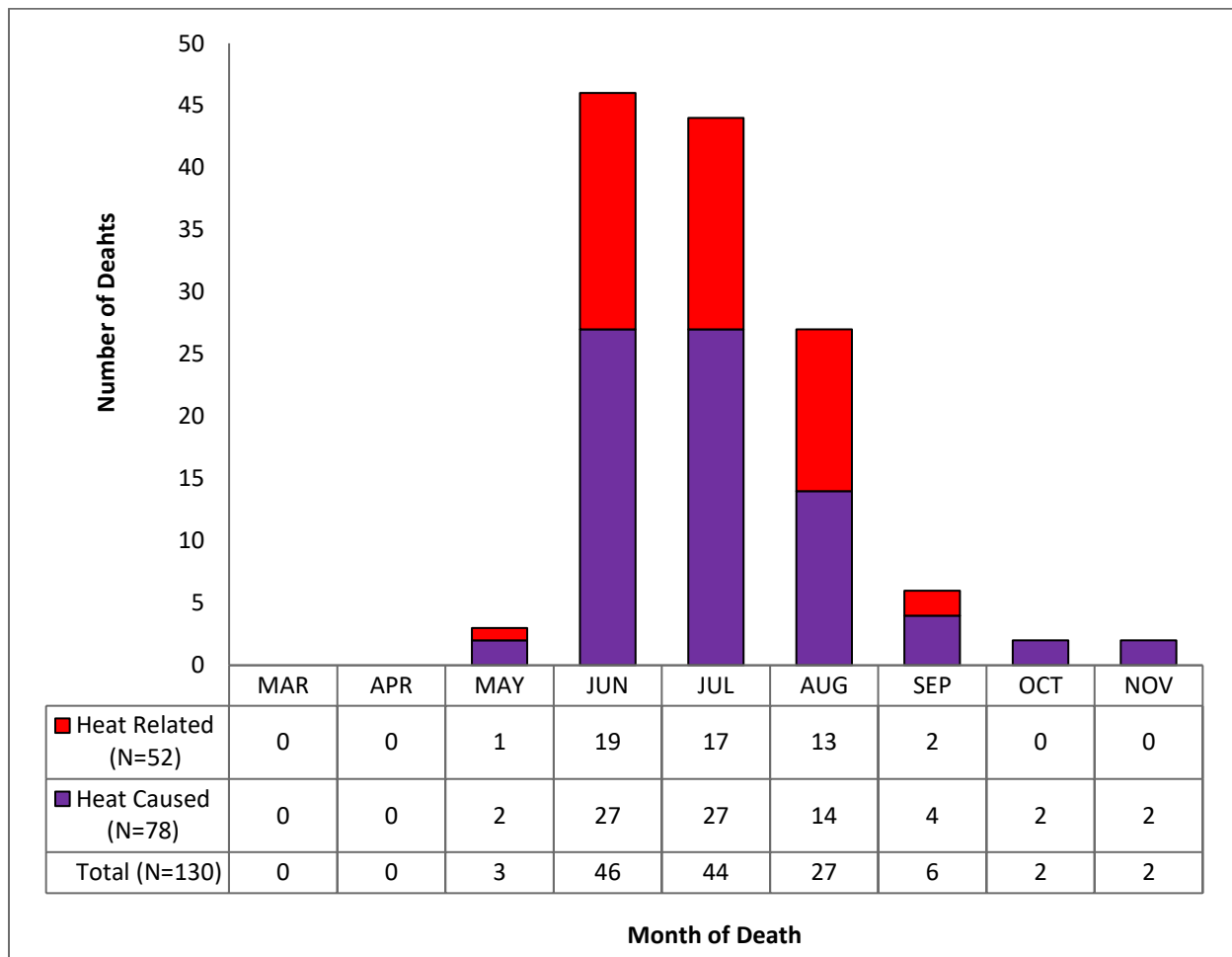
* These numbers are for heat-associated deaths reported to MCDPH as of 04/19/2017.

† Twenty seven cases are still pending a final cause of death

Heat-Associated Deaths by Month

- Ninety percent of all deaths occurred in the months of June, July and August (N=117).
- More than half (60%) of the deaths were classified as heat-caused.

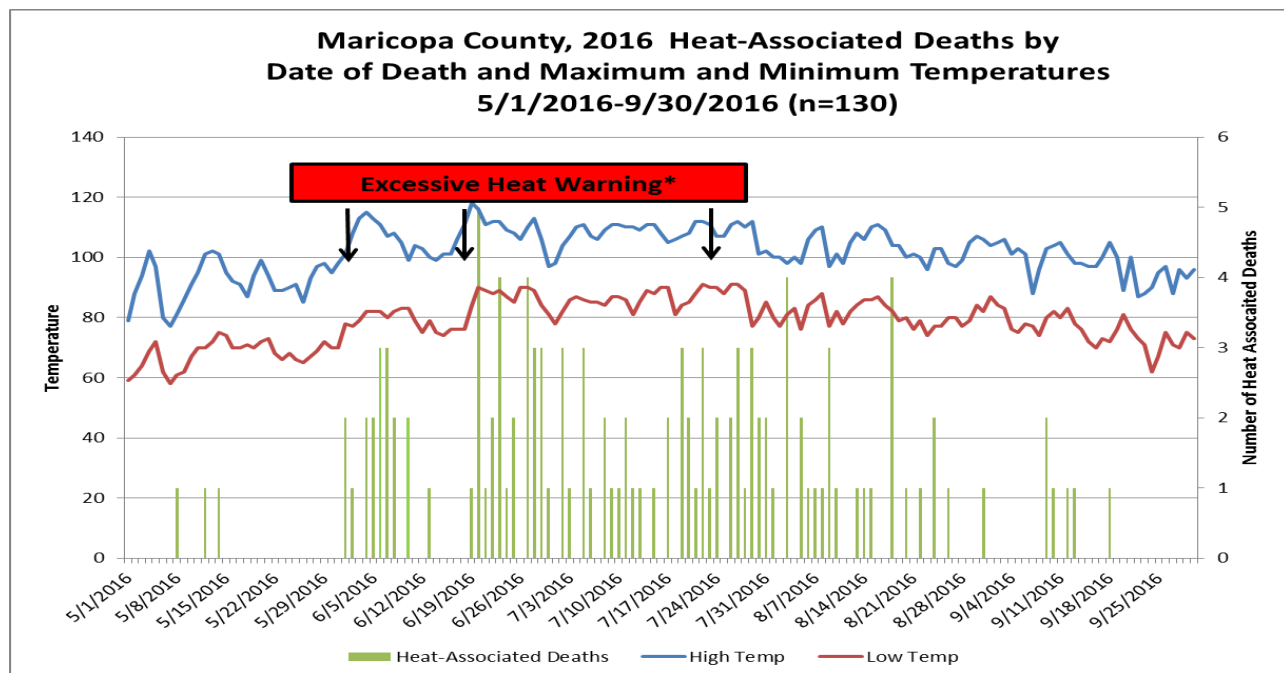
Graph 2. Heat-Associated Deaths by Month and Classification (N=130), Maricopa County, 2016



Heat-Associated Deaths and Temperatures

- The graph below shows the number of deaths that occurred each day, as well as the daily minimum and maximum temperatures.
- Excessive heat warnings are issued by the National Weather Service (NWS) for days with higher than normal temperatures.
- Three excessive heat warnings were issued in 2016.
- The highest daily maximum temperature this summer was 118°F and occurred on 6/19/2016.
- Twenty (16%) heat-associated deaths occurred during the days when an excessive heat warning was issued.

Graph 3. Maricopa County Heat-Associated Deaths by Date of Death, Maximum and Minimum Temperatures and Excessive Heat Warnings [5/01/2015-09/30/2015 (N=130)]*



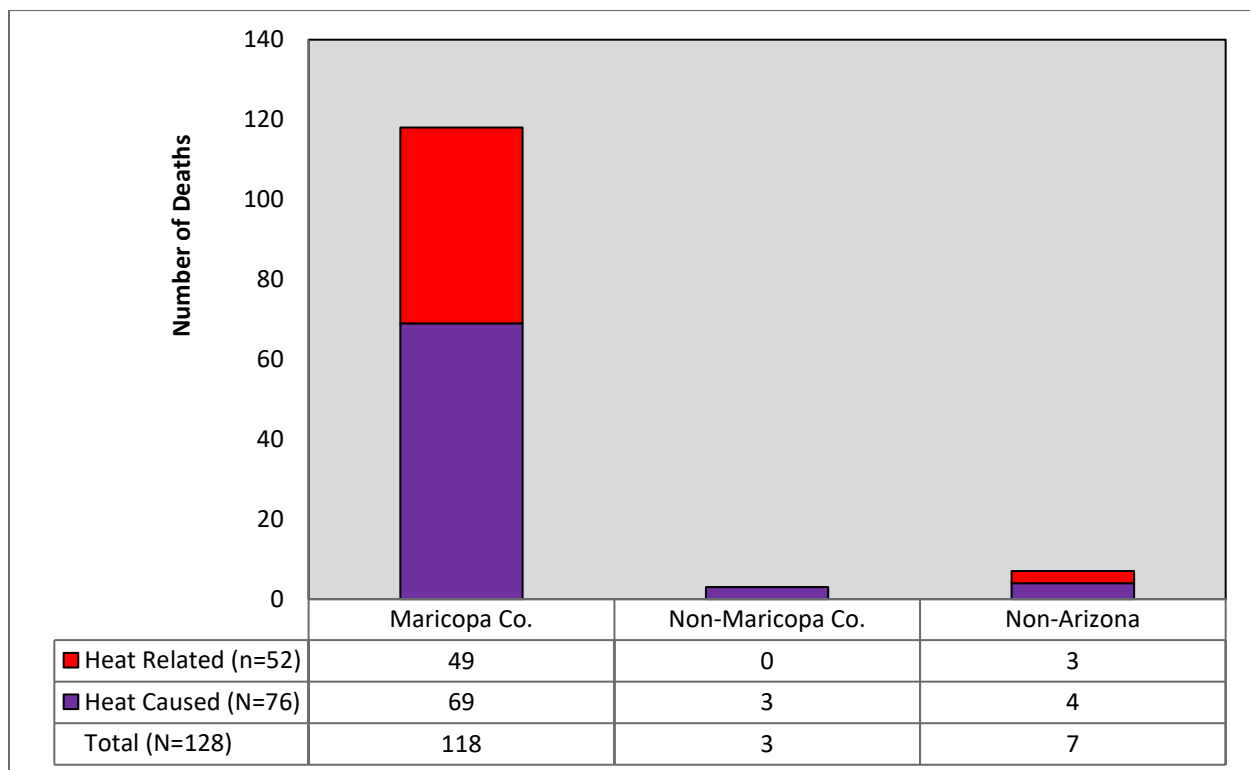
*Exact Dates of Excessive Heat Warnings: 6/03/2016-6/06/2016 (4 days), 6/18/2016- 6/23/2016 (6 days), 7/22/2016-7/23/2016 (2 days)

- In a study done by Maricopa County on the Effects of Maximum and Minimum Temperature on Deaths attributed to Environmental Heat it was found that 88% of heat associated deaths occur in the summer months.
- In the same study it was also found that both minimum and maximum are correlated to the number of deaths.
- For more information please refer to [poster 1](#) in the appendix.

Heat-Associated Deaths by Residency

- Maricopa County residents accounted for 92% (N=118) of all heat associated deaths reported in 2016.
- There were 3 residents of Arizona who lived outside of Maricopa County.
- Non-Arizona residents included 5 U.S. residents and 2 non-U.S. residents.
- Residency was not identified for two heat-associated deaths in 2016.

Graph 4. Heat-Associated Deaths by Residency (N=128)* and Classification, Maricopa County, 2016



* Excluded 2 cases with unknown residency status

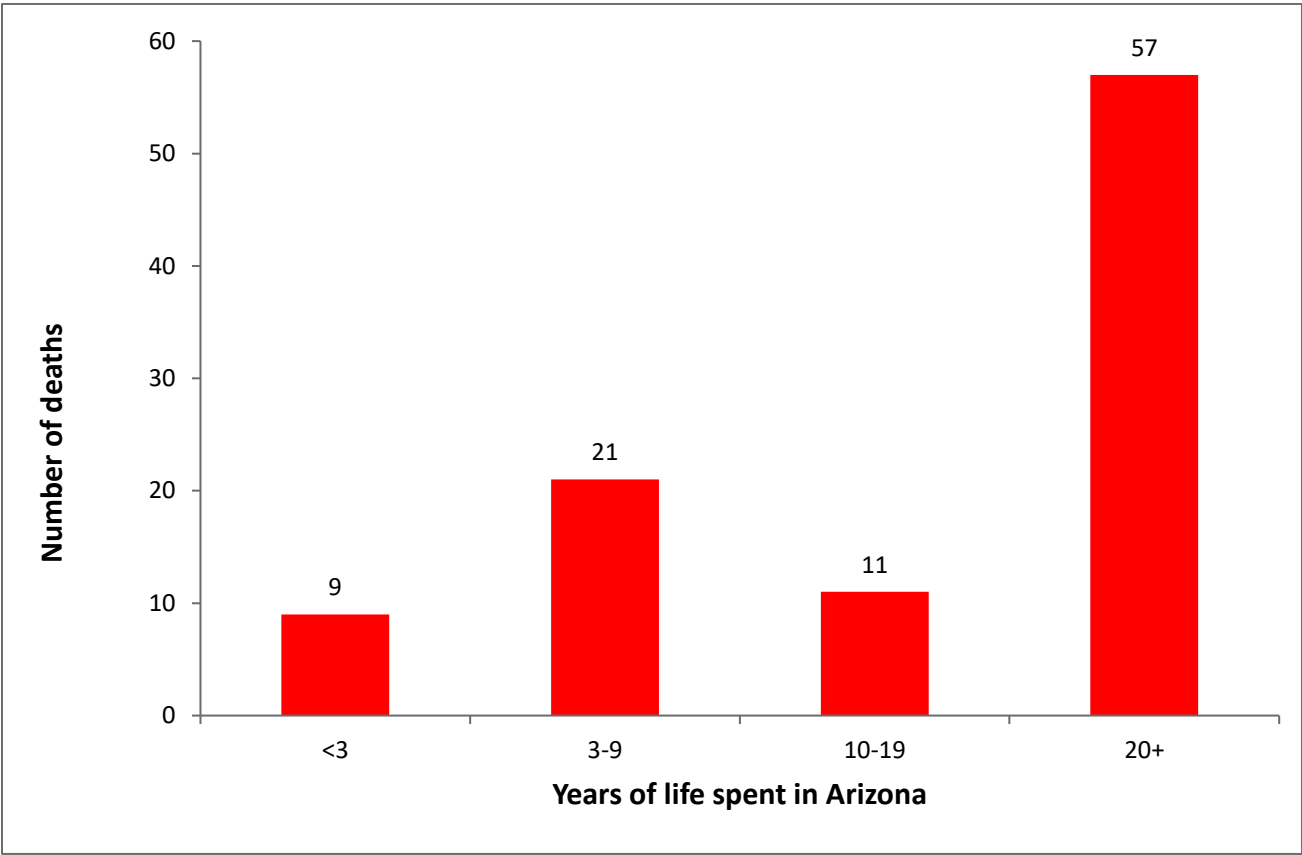
* Non-Maricopa County residents include three cases from other AZ counties: (La Paz (1) and Navajo (2)).

†Non-Arizona residents include five U.S. residents (California, North Carolina, New York, Washington, and Utah) and two non-U.S. resident (Mexico, Switzerland)

Heat-Associated Deaths by Time Spent in Arizona

- Of the 98 decedents for whom time spent in Arizona was known, 58% resided in Arizona for 20 years or more.

Graph 5. Heat-Associated Deaths by Years of Life Spent in Arizona (n=98)*, Maricopa County, 2016



* Excludes thirty two cases for which time spent in Arizona was unknown at the time of analysis.

Demographic Characteristics of Heat-Associated Deaths

- The overwhelming majority of deaths were male (72%, n=94) ([Table B](#)).
- Three deaths occurred among individuals who were 19 years old or younger.
- Most deaths occurred among individuals who were 50-64 years old (41%, N=53).
- Most of the decedents were White (67%, N=87).

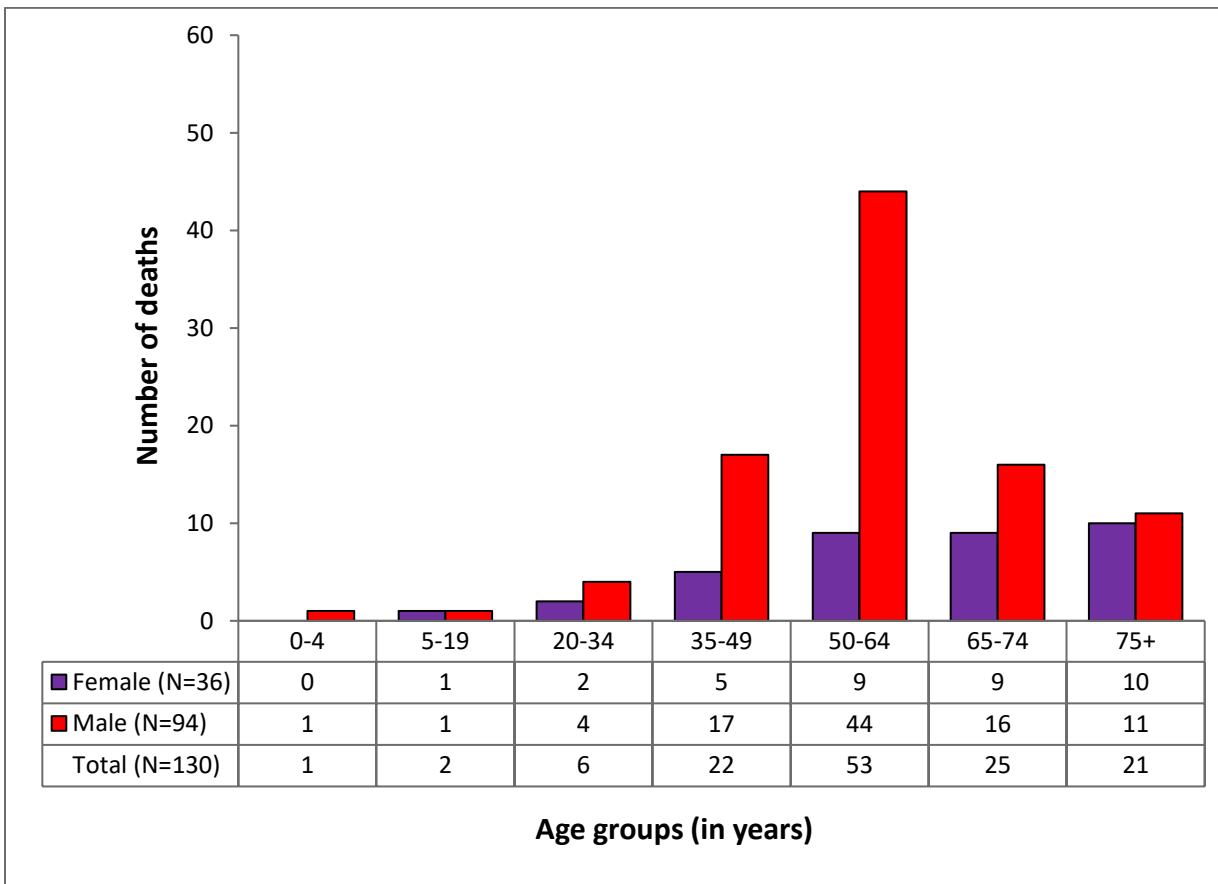
Table 1. Heat-Associated Deaths by Gender, Age, and Race/Ethnicity; Maricopa County, 2016

	TOTAL	%	Maricopa County General Population
GENDER			
Male	94	72%	49%
Female	36	28%	51%
Total	130	100%	100%
AGE GROUP			
0-4 years old	1	1%	7%
5-19 years old	2	2%	21%
20-34 years old	6	5%	21%
35-49 years old	22	17%	20%
50-64 years old	53	41%	18%
65-74 years old	25	19%	8%
75+ years old	21	16%	6%
Total	130	100%	100%
RACE/ETHNICITY			
White	87	67%	56%
Hispanic	17	13%	30%
Black	10	8%	5%
Native American	9	7%	2%
Asian/Pacific Islander	1	1%	4%
Other	2	2%	2%
Unknown	4	3%	N/A
Total	130	100%	100%

Heat-Associated Deaths by Age and Gender

- For males, the highest proportion of deaths occurred in the 50-64 age group (47%, N=44).
- For females, the highest proportions of deaths occurred in the 75+ age group (28%, N=10).

Graph 6. Heat-Associated Deaths by Age Group and Gender (N=130), Maricopa County, 2016

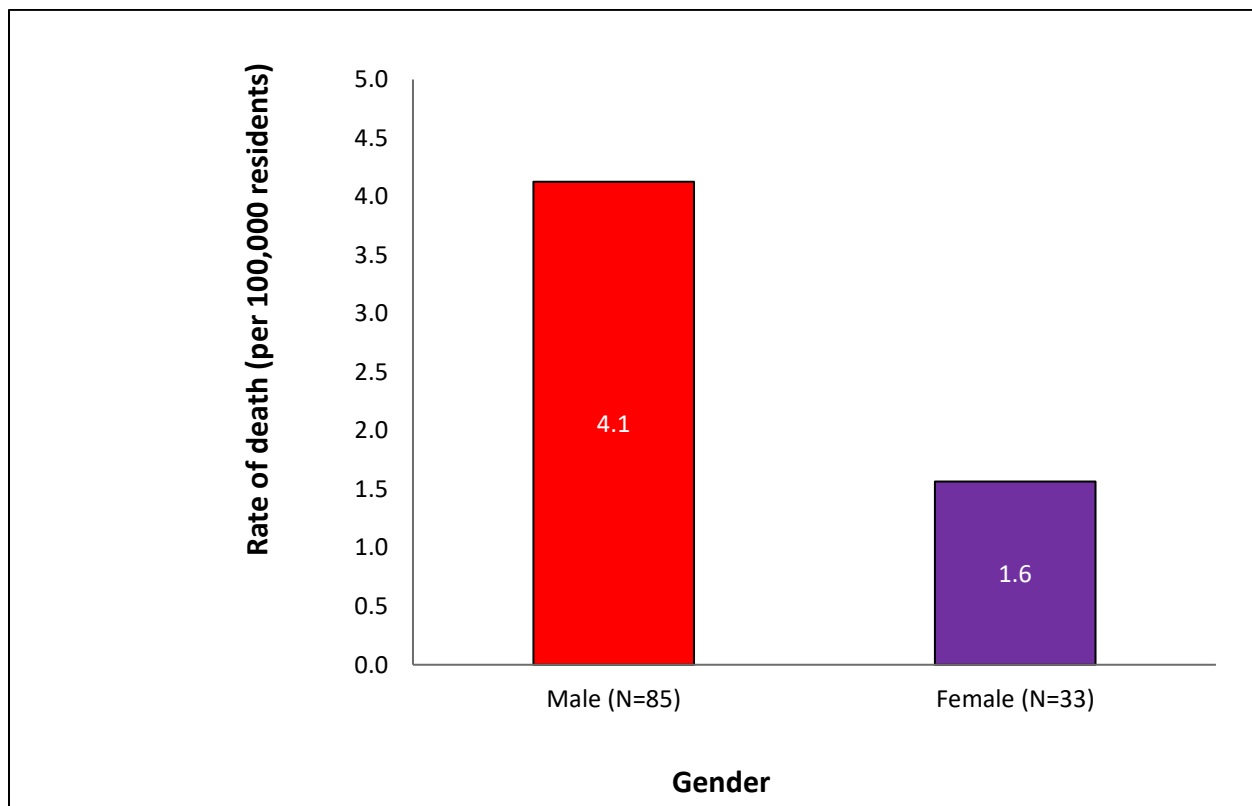


Heat-Associated Death Rates

Death Rate by Gender

- The graph below and all other graphs involving death rates only include Maricopa County residents.
- The death rate for males was 2.6 times greater than the rate for females (4.1 and 1.6 deaths per 100,000 residents, respectively).
- See Appendix [Table C](#) and [Table E](#) for more information on gender.

Graph 7. Heat-Associated Crude Death Rate per 100,000 Maricopa County Residents* by Gender (n=118), Maricopa County, 2016

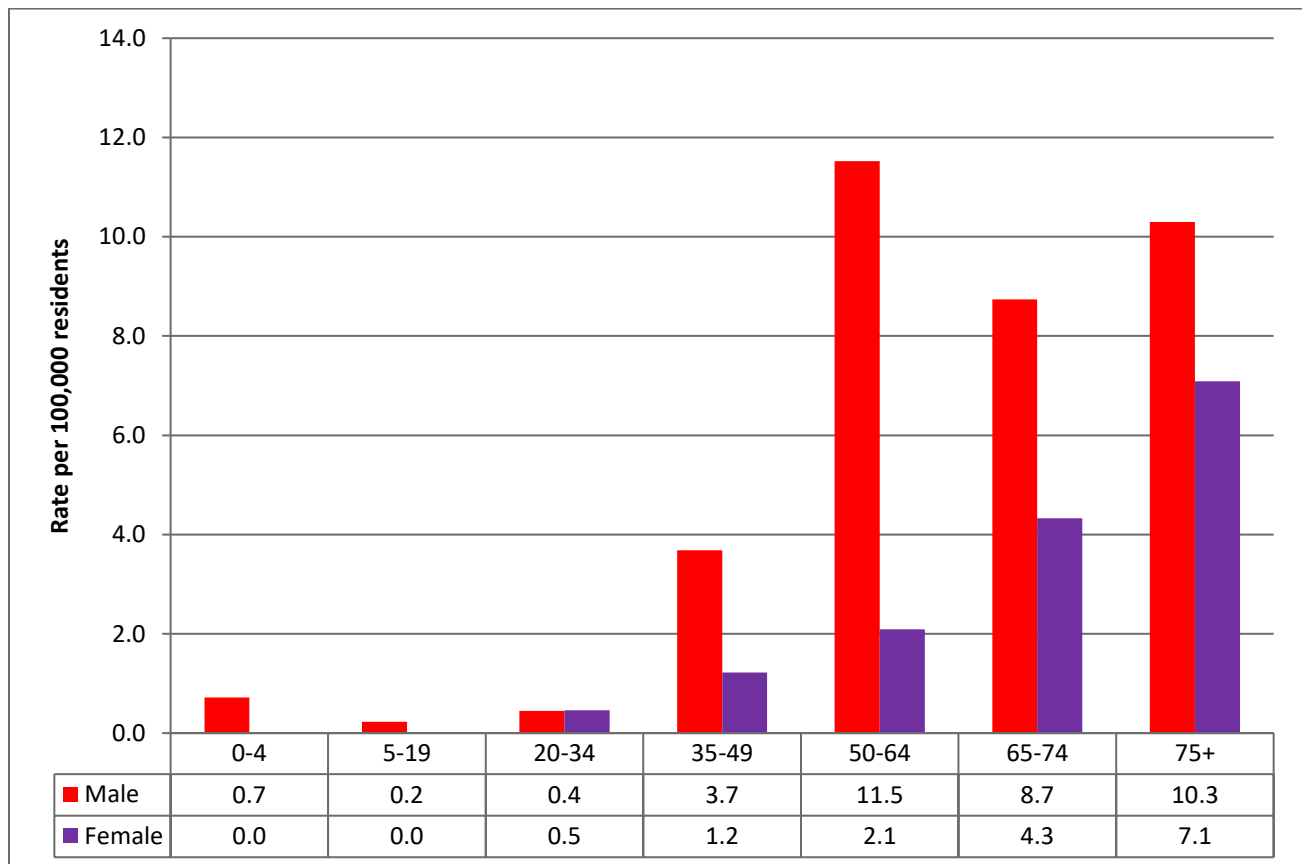


* Based on 2015 Census population estimates for Maricopa County. Excludes eight cases that were not Maricopa County residents and four cases where residence was unknown

Death Rate by Age

- The heat-associated crude death rate increases with age.
- The 75+ age group has the highest rate of heat-associated death at 8.5 per 100,000 Maricopa County Residents.
- See Appendix [Table C](#) and [Table D](#) for more information on age.

Graph 8. Heat-Associated Crude Death Rate per 100,000 Maricopa County Residents* by Age Group (n=118), Maricopa County, 2015



* Based on 2015 Census population estimates for Maricopa County. Excludes eight cases that were not Maricopa County residents and four cases where residence was unknown.

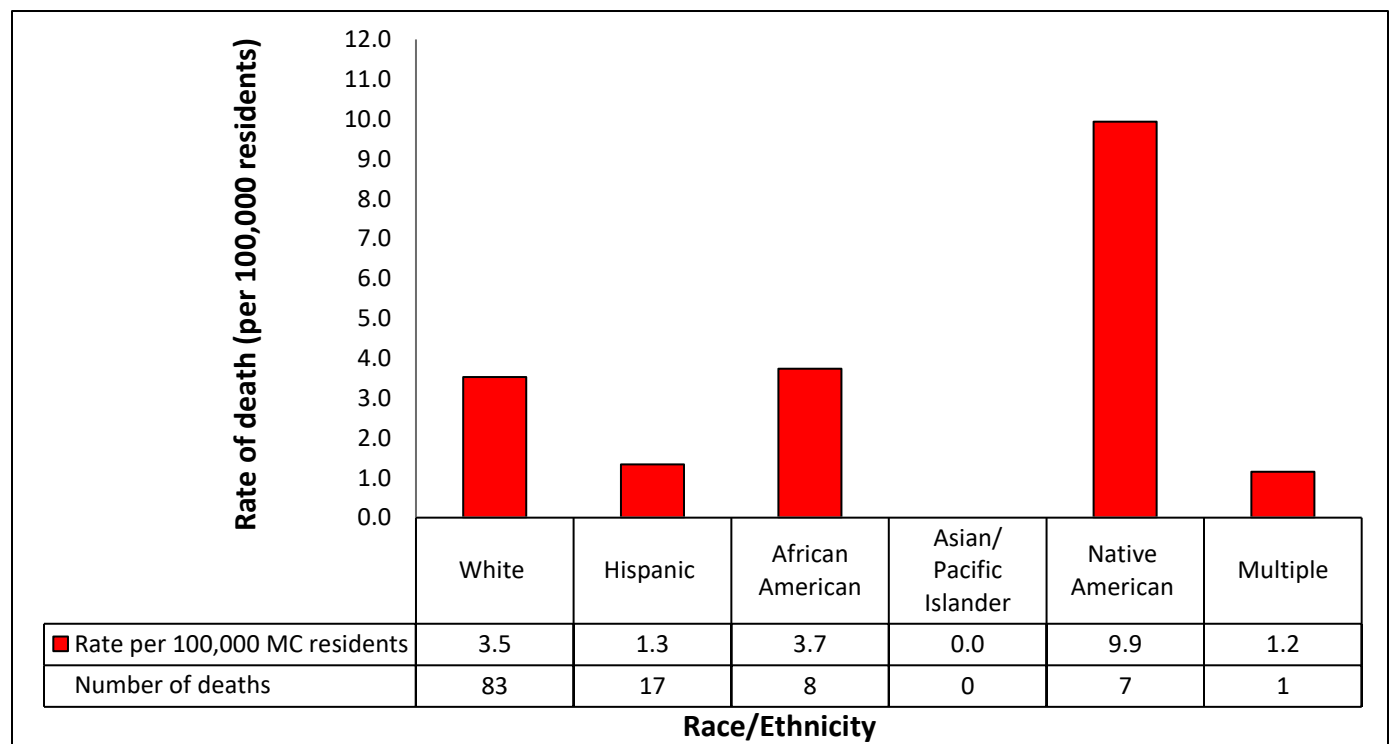
Potential Years Life Lost

- The average number of Potential Years of Life Lost (PYLL) is 22.7 years for those with heat related illness.
- The median age at death for the general population is 73.5 years with a mode of 85, whereas the median age for environmental heat related decedents was 59 with a mode of 55.

Death Rate by Race/Ethnicity

- Native American had the highest rate of heat-associated death at 9.9 per 100,000 Maricopa County residents.
- See Appendix [Table D](#) and [Table E](#) for more information on race/ethnicity.

Graph 9. Heat-Associated Crude Death Rate per 100,000 Maricopa County Residents* by Race/Ethnicity (n=116), Maricopa County, 2016

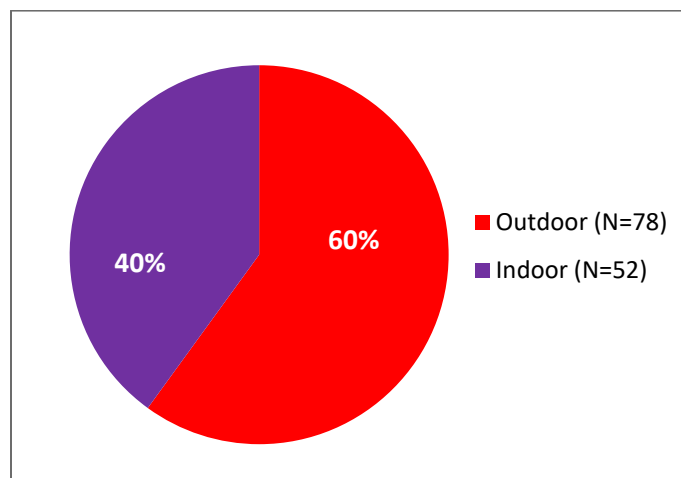


* Based on 2015 Census population estimates for Maricopa County. Excludes thirteen cases that were not Maricopa County residents or residence was unknown and one case where race/ethnicity was unknown

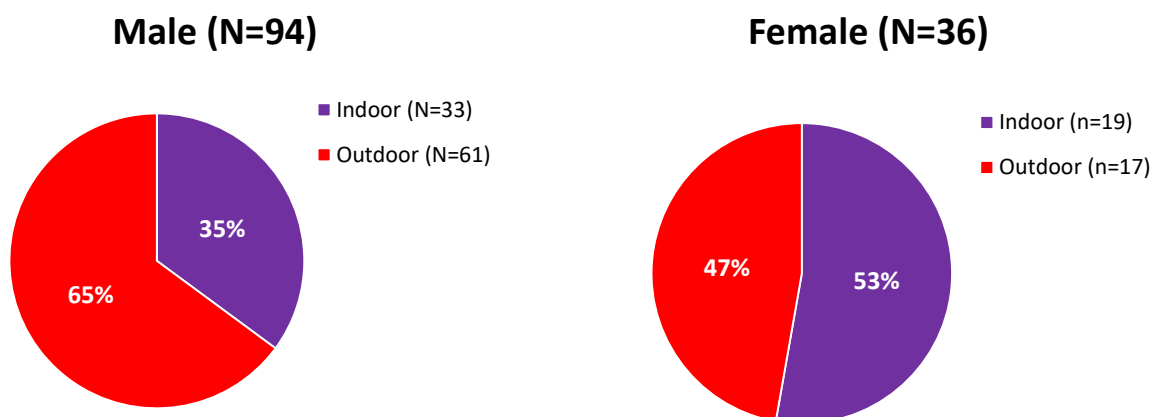
Heat-Associated Deaths by Place of Injury

- Most heat injuries occurred outdoors (60%, n=78).
- The proportion of injuries occurring outdoors was higher for males than females.
- See Appendix [Map 2](#) for more information on place of injury.

Graph 10. Heat-Associated Deaths by Place of Injury (n=130), Maricopa County 2016

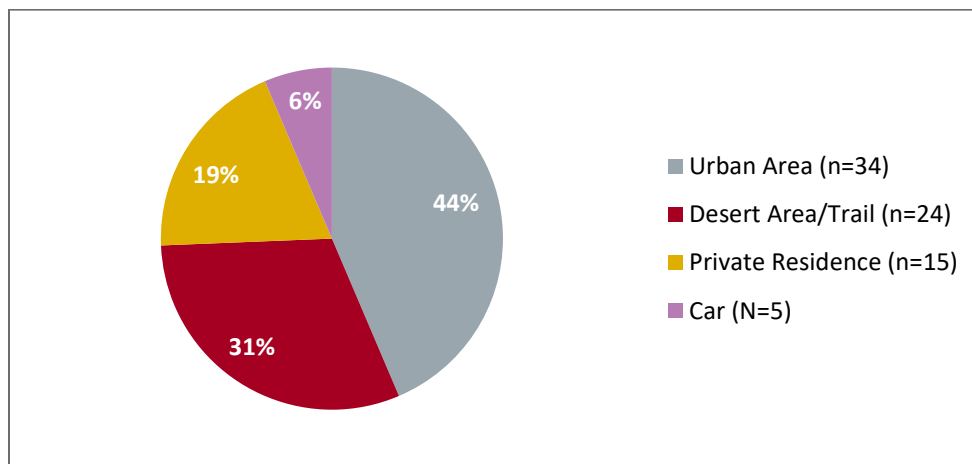


Graph 11. Heat-Associated Deaths by Place of Injury and Gender, Maricopa County 2016

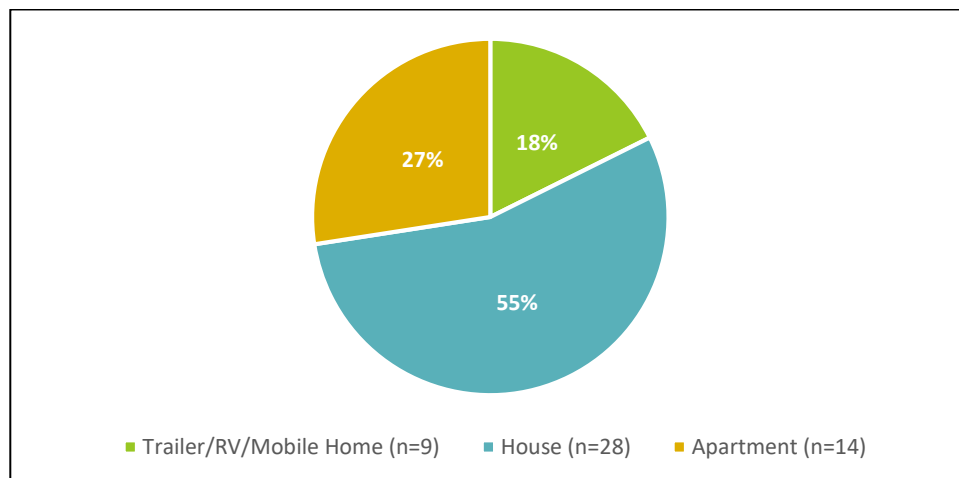


- Most outdoor deaths were injured in an urban area (44%, n=34).
- Five cases were injured in a car. Of those, all five were males. One was between 0-4 years old, one was 35-49 years old, two were 50-64 years old, and one was 65-74 years old.
- Indoor deaths occur in a decedent's residence which includes their house (55% n=28), apartment (27% n=14) or Trailer/RV/Mobile (18% n=9).
- See Appendix [Table F](#) and [Table G](#) for more information on place of injury.

Graph 12. Outdoor Heat-Associated Deaths by Place of Injury (n=78), Maricopa County 2016



Graph 13. Indoor Heat-Associated Deaths by Place of Injury (n=51), Maricopa County 2016



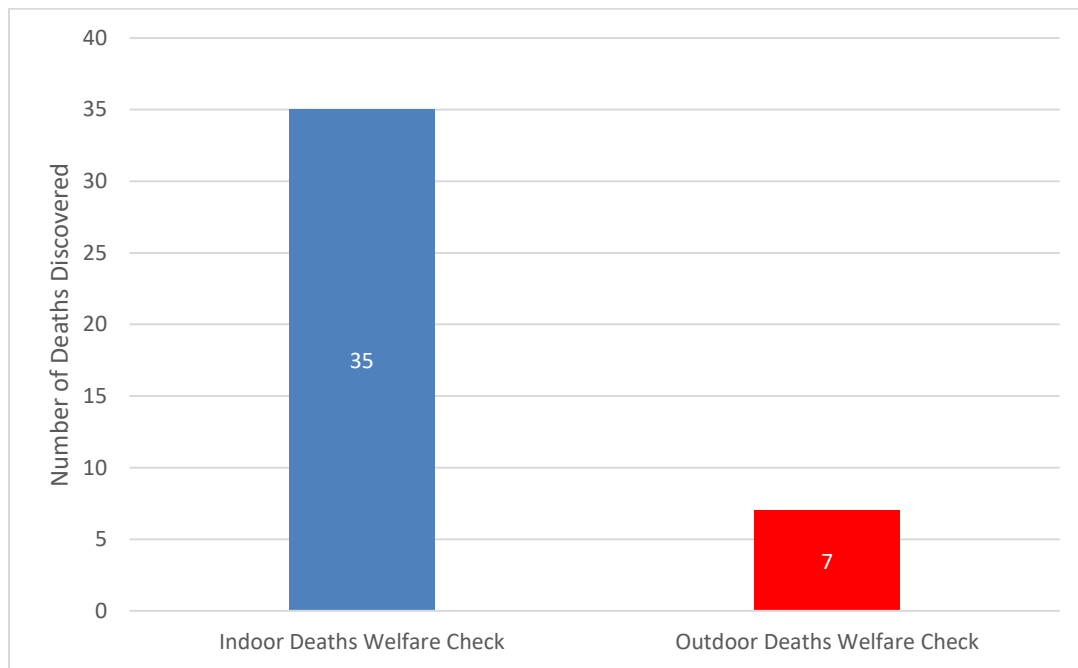
***Definitions:**

Trailer: an unpowered vehicle that is towed by another vehicle.

Recreational vehicle (RV): a motor vehicle equipped with a living space and amenities found in a home.

Mobile home: a large house trailer that is parked in one particular place and used as a permanent living accommodation.

Graph 14. Frequency of Heat-Associated Deaths Discovered Through Welfare Check (N=42), Maricopa County, 2016



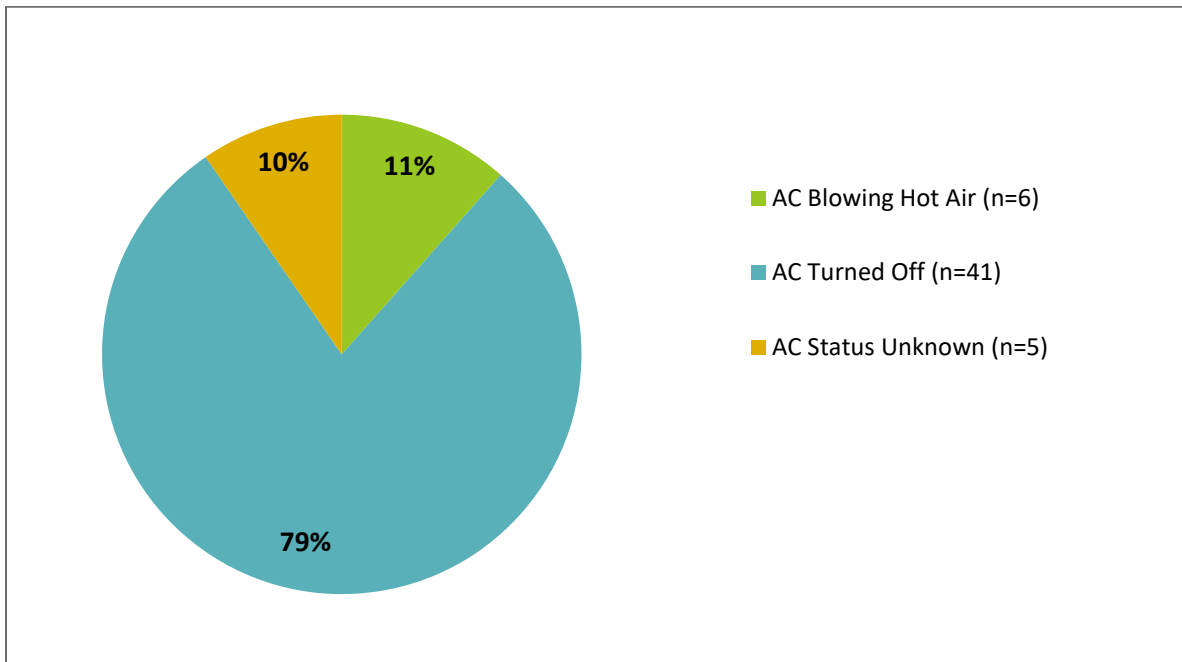
* Examples of places where people were found outdoors during welfare checks include porch, car, driveway and yard.

* A welfare check is primarily requested for police officers to complete when a person has not heard from someone for a period of time.

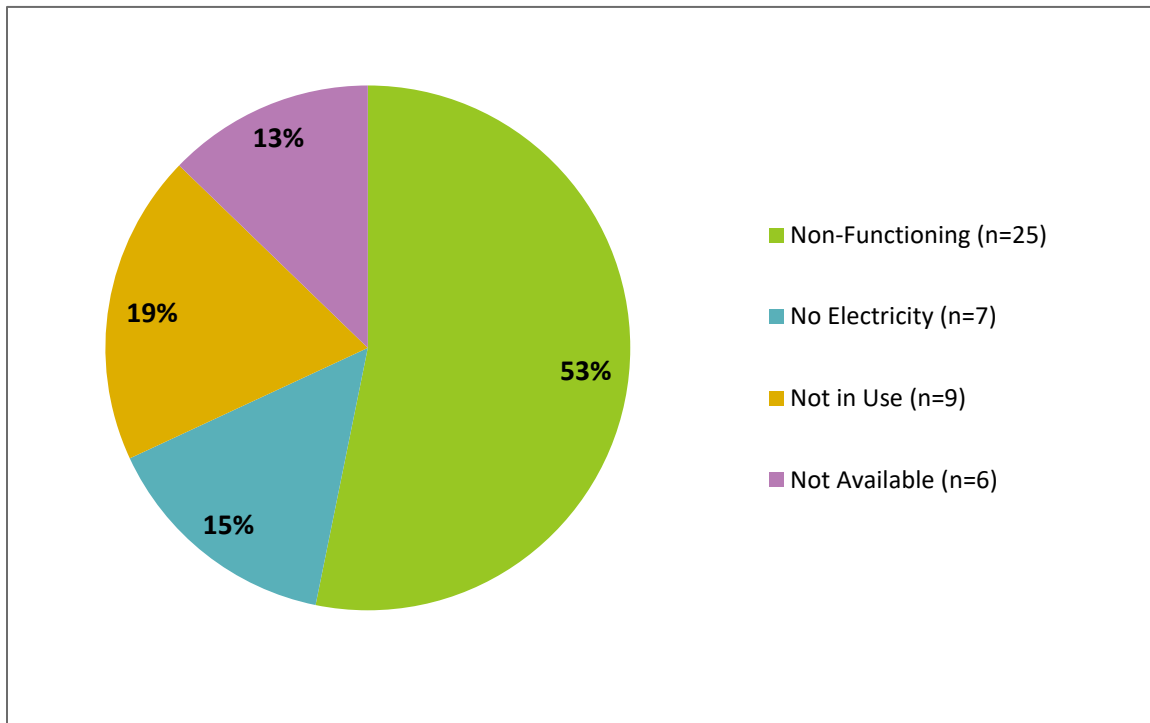
Air Conditioning Use for Indoor Deaths

- Seventy nine percent of all indoor deaths (41 out of 52) were injured in an indoor environment that was not cooled by air conditioning (AC) ([graph 15](#)).
- Six indoor deaths (11%) did have the AC turned on; however it was blowing hot air ([graph 15](#)).
- For the 47 indoor deaths that had an air conditioner present, the most common reason for not having properly running AC was that it was non-functioning ([graph 16](#)).
- See Appendix [Table H](#) for more information on AC status.

Graph 15. Heat-Associated Deaths by Use of Air Conditioning for Indoor Deaths (n=52), Maricopa County 2016



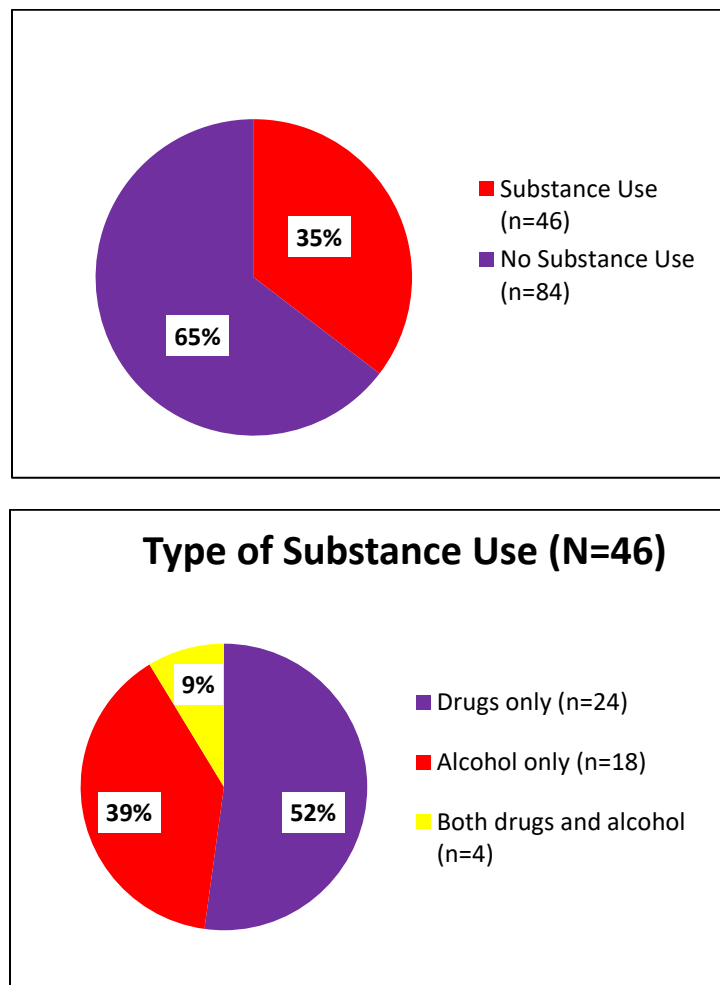
Graph 16. Reasons for not having properly running AC (n=47), Maricopa County 2015



Substance Use among Heat-Associated Deaths

- Thirty five percent (n=46) of heat-associated deaths had substance use mentioned on their death certificates.
- Drugs was the most common form of substance use. Sixty one percent (n=28) of all heat-associated deaths had drug use mentioned on their death certificate.

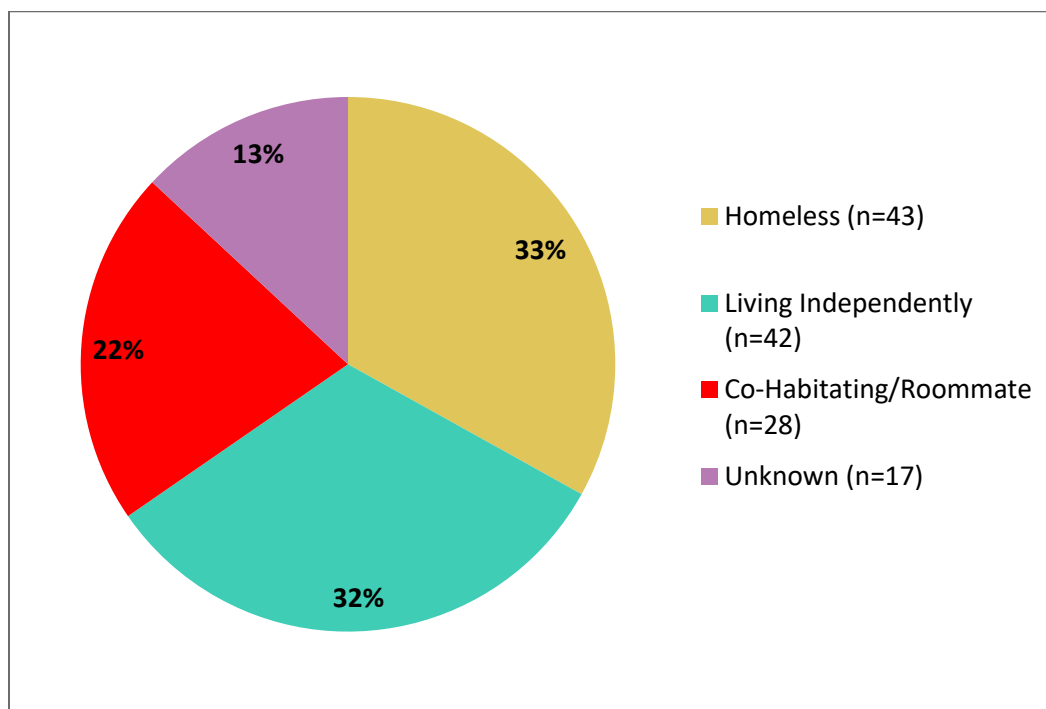
Graph 17. Substance Use, as Mentioned on the Death Certificate for Heat-Associated Deaths (N=130), Maricopa County, 2016

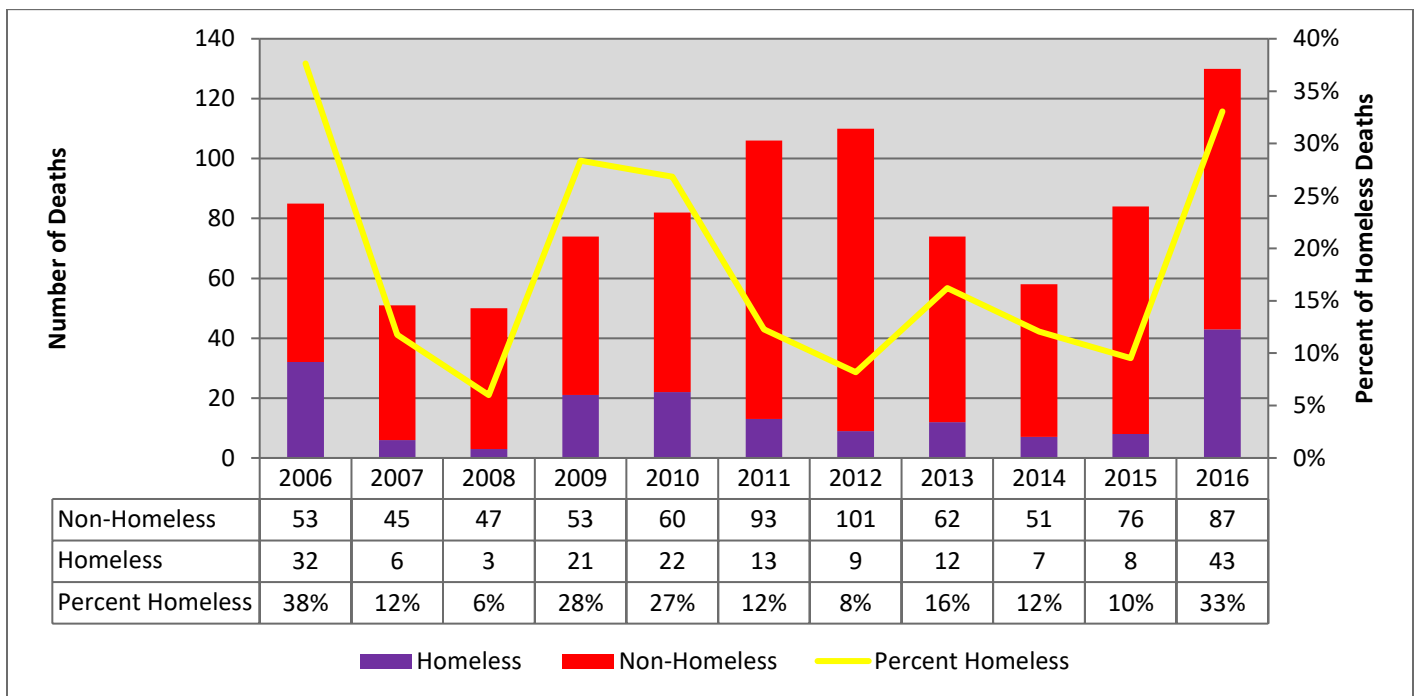


Living Situation among Heat-Associated Deaths

- Thirty-three percent of all heat-associated deaths in 2016 were homeless.
- The majority of the homeless deaths were male and between 50 and 64 years old (49%, n=21).
- All of the homeless deaths occurred outside.
- For more information on how homeless status is determined, see the definition of homelessness in the [Appendix](#).

Graph 18. Living Situation of Heat-Associated Deaths, Maricopa County, 2016



Graph 19. Homeless Death and Non-Homeless Deaths 2006-2016, Maricopa County**Table 2: Homeless Heat Associated Deaths Demographics 2016, Maricopa County (N=43)**

	TOTAL	%
GENDER		
Male	37	86%
Female	6	14%
Total	43	100%
AGE GROUP		
0-4 years old	0	0%
5-19 years old	0	0%
20-34 years old	3	7%
35-49 years old	14	33%
50-64 years old	21	49%
65-74 years old	4	9%
75+ years old	1	2%
Total	43	100%

Conclusions

- There were 48% more heat-associated deaths in 2016 compared to 2015.
- Three excessive heat warnings were issued in the summer of 2016, and ranged in duration from 2 to 6 days. During those days 16% of the heat associated deaths occurred.
- Most of the deaths occurred in the months of June, July and August.
- There were more heat-caused deaths than heat-related deaths.
- The majority of cases were residents of Maricopa County. Furthermore, most cases had lived in Arizona for 20 years or more.
- Overall, there were much fewer deaths among females than among males
- Among Maricopa County residents, the rate of heat-associated deaths was the highest for males, those 75 years old and older, and Native Americans.
- The majority of cases were injured outdoors. The most common place of injury for the outdoor deaths was an urban area. The most common place of injury for indoor deaths was at the decedent's residence.
- Most cases that were injured indoors were in an environment that was not cooled by air conditioning (74%, n=39).
- Drugs or alcohol were mentioned in the death certificate for 46% of the cases.
- Thirty three percent of heat-associated deaths occurred among homeless individuals.
- The average years lost for those with heat related deaths was 22.7 years with the median age of the decedents being 59 years old.

Appendix

Background

In July 2005, Maricopa County (MC) experienced exceptionally high temperatures that contributed to 45 deaths, of which 35 occurred over nine consecutive days. Temperatures reached 116° F and three excessive heat warnings were issued during this month. After this event, the Maricopa County Department of Public Health (MCDPH) created a novel and effective approach for surveillance of heat-associated deaths in 2006 and has continued to use this system annually.

Methodology

Surveillance data is obtained from the following sources:

1. The Maricopa County Office of the Medical Examiner (OME) forwards suspected heat-related deaths to MCDPH and provides data including demographics, preliminary information regarding how the death occurred, and the circumstances of death. In the past, this information came solely as a weekly line list with limited information for each case. However, in February of 2012, MCDPH started receiving all preliminary reports of death (PRODs) from the OME. These reports provide expanded information on a daily basis and have changed the screening methods used by MCDPH staff to ensure that all potential heat-related deaths are documented.
2. The MCDPH Office of Vital Registration registers all Maricopa County death certificates in the Arizona Department of Health Services vital records database. The MCDPH Office of Epidemiology searches this database looking for causes of death associated with environmental heat. A Statistical Analysis Software (SAS) program looks for the key phrases and International Classification of Disease-10 (ICD-10) codes listed below.

Key Phrases
HEAT EXPOSURE
ENVIRON
EXHAUSTION
SUN
HEAT STRESS
HEAT STROKE
HYPERTHERMIA

ICD 10 Code	Corresponding Definition
X30	Exposure to excessive natural heat
T67.X	Effects of heat and light
P810	Environmental hyperthermia of newborn

3. Hospital and media reports can sometimes initiate a heat death investigation, for example, if a child is reportedly left in a hot car.

Once data are received, analysis of the information is required to identify only those deaths caused as a result of environmental heat. Environmental heat is heat generated by the climate (sun, humidity, etc.) rather than heat from man-made sources such as ovens or manufacturing equipment. Heat-associated deaths are categorized based on the classification criteria listed below:

Heat-caused (HC) deaths are those in which environmental heat was directly involved in the sequence of conditions causing deaths. These are deaths where environmental heat terms were indicated in **Part I¹** of the death certificate causes of death (diseases or conditions in the direct sequence causing death), for cause of death variables (*cod_a*, *cod_b*, *cod_c*, or *cod_d*). County of death: Maricopa.

Heat-related (HR) deaths are those in which environmental heat contributed to the deaths but was not in the sequence of conditions causing these deaths. These are cases where environmental heat terms were mentioned in **Part II²** of the death certificate causes of death (diseases and conditions contributing but not directly resulting in the death sequence), but not in any of the Part I death variables (*cod_a*, *cod_b*, *cod_c*, or *cod_d*). County of death: Maricopa.

For the purposes of this report, heat-caused and heat-related deaths are combined and referred to as “heat-associated deaths.” Please note that most jurisdictions report only heat-caused deaths. This should be considered when comparing Maricopa County data with data from other locations.

Death certificate data, in combination with the OME notes, are used to produce the information that is contained in this report. Total case count, demographics, residency, drug/alcohol use, and years lived in Arizona are directly retrieved from death certificate data. Place of death location, indoor/outdoor occurrence, air conditioning use, and homelessness are retrieved based on explicit notations made in the death certificate and/or OME notes.

Homelessness is defined as having an address on the death certificate that matches a homeless shelter, government agency, business, or an intersection. Cases are also classified as homeless if there is an indication on the death certificate. If the address is listed as unknown on the death certificate then an examination of the medical examiner’s notes is made to determine if there is a reference to an address - if none, then the person is classified as homeless. If the address is listed as out of jurisdiction then time spent in Arizona, as provided by the death certificate, is taken into consideration.

Once classification is completed, the data are summarized for the production and dissemination of reports. Reports are generated weekly during the season and posted to the MCDPH website which can be found at: <http://www.maricopa.gov/publichealth/Services/EPI/Reports/heat.aspx>

¹ **Part I of the death certificate:** *cod a* – is the immediate cause (final disease or condition resulting in death) *cod b*, *cod c*, *cod d* – are sequentially listed conditions leading to the cause listed on *cod a*.

² **Part II of the death certificate:** Other significant conditions contributing to death but not resulting in the underlying cause given in Part I.

Appendix Tables

Table A. Heat-Associated Deaths Reported by Investigation Status, Maricopa County, 2006-2016

Year	Total Reported N	Confirmed N (%)	Ruled-Out N (%)	Pending N (%)
2006	104	85 (82%)	19 (18%)	0 (0%)
2007	131	51 (39%)	80 (61%)	0 (0%)
2008	97	50 (52%)	47 (48%)	0 (0%)
2009	114	74 (65%)	40 (35%)	0 (0%)
2010	142	82 (58%)	60 (42%)	0 (0%)
2011	144	106 (74%)	38 (26%)	0 (0%)
2012	173	110 (64%)	63 (36%)	0 (0%)
2013	145	76 (52%)	69 (48%)	0 (0%)
2014	115	61 (53%)	54 (47%)	0 (0%)
2015	144	85 (59%)	59 (41%)	0 (0%)
2016	233	130 (56%)	76 (33%)	27* (12%)
Total	1,542	910 (59%)	605 (39%)	27 (1%)

Data Sources: Maricopa County, Office of Vital Registration and Office of Medical Examiner; Arizona Department of Health Services, Office of Vital Registration

The numbers reported here are for heat-associated deaths reported to MCDPH as of 04/19/2017.

* Twenty seven cases are still pending a final cause of death classification for 2016

Table B. Heat-Associated Deaths by Gender and Age Group, Maricopa County, 2016

Age Group	Deaths by Gender					
	Male n (%)		Female n (%)		Total n (%)	
0-4	1	1%	0	0%	1	1%
5-19	1	1%	1	3%	2	2%
20-34	4	4%	2	6%	6	5%
35-49	17	18%	5	14%	22	17%
50-64	44	47%	9	25%	53	41%
65-74	16	17%	9	25%	25	19%
75+	11	12%	10	28%	21	16%
All Ages	94	72%	36	28%	130	100%

Table C. Heat-Associated Deaths Rates per 100,000 Residents* by Gender and Age Group, Maricopa County, 2016

Age Group	Gender Rate per 100,000 (n)		
	Male	Female	Total
0-4	0.7 (1)	0.0 (0)	0.4 (1)
5-19	0.2 (1)	0.0 (0)	0.1 (1)
20-34	0.5 (2)	0.5 (2)	0.5 (4)
35-49	3.7 (15)	1.2 (5)	2.5 (20)
50-64	11.8 (41)	2.1 (8)	6.8 (49)
65-74	9.2 (14)	4.6 (8)	6.7 (22)
75+	10.7 (11)	7.3 (10)	8.8 (21)
All Ages	4.2 (85)	1.3 (33)	2.9 (118)

* Based on 2015 Census population estimates for Maricopa County. Excludes twelve cases that were not Maricopa County residents or residence was unknown

Table D. Heat-Associated Deaths Rates per 100,000 Residents* by Age Group and Race/Ethnicity, Maricopa County, 2016

Race/Ethnicity	Age Group Rate per 100,000 (n)							
	0-4	5-19	20-34	35-49	50-64	65-74	75+	Total
White	0.0 (0)	0.6 (1)	0.5 (2)	3.1 (14)	6.9 (34)	7.0 (17)	7.8 (15)	3.5 (81)
Hispanic	1.7 (1)	0.0 (0)	0.3 (1)	0.0 (0)	8.1 (10)	5.9 (2)	15.9 (3)	1.4 (17)
Black	0.0 (0)	0.0 (0)	2.1 (1)	4.9 (2)	6.5 (2)	11.2 (1)	40.5 (2)	4.0 (8)
Asian/Pac. Islander	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
Native American	0.0 (0)	0.0 (0)	0.0 (0)	18.4 (3)	29.9 (3)	38.2 (1)	0.0 (0)	8.4 (7)
All Race/Ethnicities	0.4 (1)	0.1 (1)	0.5 (4)	2.4 (19)	7.2 (49)	7.1 (21)	9.0 (20)	2.9 (115)

* Based on 2015 Census population estimates for Maricopa County. Excludes twelve cases that were not Maricopa County residents or residence was unknown and three cases where race was unknown.

Table E. Heat-Associated Deaths Rates per 100,000 Residents* by Gender and Age Group, Maricopa County, 2016

Race/Ethnicity	Gender Rate per 100,000 (n)		
	Male	Female	Total
White	4.9 (56)	2.3 (27)	3.5 (83)
Hispanic	2.5 (15)	0.3 (2)	1.4 (17)
Black	5.0 (5)	3.1 (3)	4.0 (8)
Asian/Pac. Islander	0.0 (0)	0.0 (0)	0.0 (0)
Native American	17.6 (7)	0.0 (0)	8.4 (7)
All Races	4.2 (83)	1.6 (32)	2.9 (115)

* Based on 2015 Census population estimates for Maricopa County. Excludes eleven cases that were not Maricopa County residents and two cases where race was unknown

Table F. Heat-Associated Deaths by Place Injury Occurred and Age Group, Maricopa County, 2016

Age Group	Indoor (n=52)	Outdoor (n=76)						
	Private Residence	Private Residence	Desert Area/ Trail	Car	Urban Area			
					Business	Street/ Alley	Field/ Park	Shed
0-4	0	0	0	1	0	0	0	0
05-19	0	0	2	0	0	0	0	0
20-34	2	0	3	0	0	3	0	0
35-49	2	0	11	1	1	6	0	0
50-64	24	5	6	2	1	10	3	0
65-74	12	5	1	1	0	5	1	0
75+	12	5	1	0	0	3	0	0
Total	52	15	24	5	2	27	4	0

Table G. Heat-Associated Deaths by Indoor or Outdoor Occurrence, Age Group, and Gender, Maricopa County, 2016

Age Group	Indoor			Outdoor		
	Male	Female	Total	Male	Female	Total
0-4	0	0	0	1	0	1
5-19	0	0	0	1	1	2
20-34	0	0	0	4	2	6
35-49	1	1	2	16	4	20
50-64	20	6	26	24	3	27
65-74	7	5	12	9	4	13
75+	5	7	12	6	3	9
Total	33	19	52	61	17	78

Table H. Heat-Associated Deaths by Use of Air Conditioning (AC) and Age Group, (Indoor Only)
Maricopa County, 2016

Age Group	AC On	AC Off	AC Not Present	AC Status Unknown	Total
0-4	0	0	0	0	0
5-19	0	0	0	0	0
20-34	0	0	0	0	0
35-49	1	1	0	0	2
50-64	0	17	6	3	24
65-74	3	8	0	1	12
75+	2	9	0	1	11
Total	6	35	6	5	52

Table I. Heat-Associated Deaths by Smoking/Tobacco Use, Maricopa County, 2016

Smoking/Tobacco Use	n (%)
Yes	15 (12%)
No	115 (88%)
Unknown	0 (0%)
Total	130 (100%)

Table J. Heat-Associated Deaths by Education Category, Maricopa County, 2016

Education Category	n (%)
8 th grade or less	12 (9%)
9 th through 12 th grade; no diploma	11 (8%)
High school graduate or GED completed	41 (32%)
Some college credit, but no degree	16 (12%)
Associate degree (e.g.AA,AS)	3 (2%)
Bachelor's degree (e.g.BA,BS)	13 (10%)
Master's degree (e.g.MA,MS,MEng,MEd,MSW,MBA)	6 (5%)
Doctorate (e.g.PhD,EdD) or Professional degree (e.g.MD,DDS,DVM,LLB,JD)	1 (1%)
Unknown	27 (21%)
Total	130 (100%)

Poster 1. The Effects of Maximum and Minimum Temperatures on Deaths Attributed to Environmental Heat in Maricopa County, 2006-2013

#5351

The Effects of Maximum and Minimum Temperatures on Deaths Attributed to Environmental Heat in Maricopa County, 2006-2013

Benita McKinney, MPH, Vjollca Berisha, MD, MPH, Katherine Muenster MPH, Ahmed Mohamed, PhD, Kate Goodin, MPH
Maricopa County Department of Public Health, Office of Epidemiology, Phoenix, Arizona, USA

4041 N. Central Ave, Ste 600
Phoenix, AZ 85012
Phone: 602-372-2605
Fax: 602-372-2610
epidemiology@mail.maricopa.gov

INTRODUCTION

Officially, enhanced heat surveillance begins in May and continues through October of each year. Environmental heat-associated deaths (HA) in Maricopa County (MC) are highest during the months of June, July, and August. During this period, the temperatures range from 92-118°F for maximum daytime temperature, and 71-96°F for nighttime temperature. Prolonged exposure to the combination of high maximum and high minimum temperatures has been thought to inhibit adequate body cooling, therefore, the number of heat-associated deaths tend to increase during these months.

OBJECTIVE

The purpose of this study is to investigate the relationship between environmental heat and mortality in Maricopa County, Arizona in order to determine the association between daily maximum and minimum temperatures and attributed deaths.

METHODOLOGY

Study Design

- Data Sources:
 - o Maricopa County Death Database - used keywords and ICD codes to identify HA deaths
 - o National Weather Service Website - acquired minimum and maximum temperatures
- Inclusion Criteria:
 - o Heat Associated deaths occurring in the months of June, July and August for years 2006-2013.

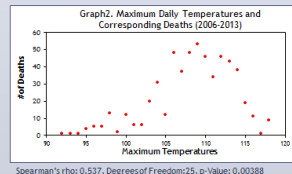
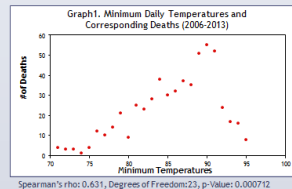
Statistical Analysis

- Descriptive
 - o Calculated the percentage of deaths among all MC deaths for the study period
 - o Calculated the number of HA deaths in a given temperature range
 - o Calculated Age Specific Mortality Rates and determined the characteristics for the most affected age
 - o Identified the number of deaths occurring indoors and outdoors within the minimum and maximum temperature ranges to identify high risk activities
- Spearman's Correlation
 - o Correlation coefficients were calculated between the number of deaths and the minimum and maximum temperature.
 - o Calculated Potential Years of Life Lost for all HA

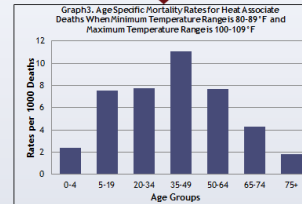
RESULTS

Table 1. Temperature Range and Corresponding Deaths (2006-2013)

Minimum Temperature Range	Total Number of Deaths	Percentage of Deaths
71-79°F	72	13.0
80-89°F	308	56.0
90-96°F	172	31.0
Maximum Temperature Range	Total Number of Deaths	Percentage of Deaths
90-99°F	32	6.0
100-109°F	273	49.0
110-118°F	247	45.0



35% of deaths occurred when the minimum temperature range was 80-89°F and the maximum temperature range was 100-109°F



Characteristics of 35-49 year olds

- This was the most affected age group when both the highest percentage of deaths within the minimum and maximum temperature ranges were considered
- The Age Specific Mortality rate is 11.0/1000 deaths
- Median age 45, (compared to 58 years old for all heat associated deaths), Mode is 49
- Potential Years of Life Lost is 32.9 (compared to 19.9 for all heat associated deaths)
- 83% of these heat associated deaths occurred outdoors
- Within this age group 24 (21%) have outdoor occupations and were outdoors when the death occurred; only 5 of these 24 are classified as occupational related deaths

CONCLUSION

- The summer months account for 88% of all Heat Associated deaths
- Both minimum and maximum temperatures are significantly correlated to the number of deaths:
 - o Minimum Temperature $p=0.000712$
 - o Maximum Temperature $p=0.00388$
- 56% of deaths occurred when the minimum temperature range was 80-89°F; 49% of deaths occurred when the maximum temperature range was 100-109°F
- when minimum and maximum temperature ranges are considered
 - o 35-49 year olds have the highest rate
 - o We assumed that occupation might play a role in the rate
 - o This accounts for roughly one-third of Potential Life Years being lost amongst these decedents

FUTURE ACTIONS

- Explore the relationship between daily average temperatures, humidity, and heat associated deaths.
- Expand the investigation to include heat related illness
- Further investigate the relationship between age groups and heat associated deaths
- Identify occupational and recreational activities at time of illness/death

ACKNOWLEDGEMENTS

- Darcie Bentz, Public Health Associate
- Carrie Walker, MPH
- MCDPH Office of Vital Registration